Module 4 Practice problem and Homework answers

Practice Problems, pages 2 – 3

OBSERVED	cat	no cat	total
over	**3**	**7**	10
under	**9**	**3**	12
total	12	10	22

The observed table simply summarizes the data from page 1.

page 4

EXPECTED	cat	no cat	total
over			10
under			12
total	12	10	22

The marginal totals in an expected values table are exactly the same as those in an observed values table.

page 5

EXPECTED	cat	no cat	total
over	**A**	**B**	10
under	**C**	**D**	12
total	12	10	22

To calculate the expected value for each cell, use this formula:

$$fe = (row\ total * column\ total)/N$$

Cell A: (10*12)/22 = 5.45 Cell B: (10*10)/22 = 4.55

Cell C: (12*12)/22 = 6.55 Cell D: (10*12)/22 = 5.45

page 6

observed	expected	(observed-expected)	(observed-expected)^2	(observed-expected)^2/ expected
3	5.45	**A**	**E**	
7	4.55	**B**	**F**	
9	6.55	**C**	**G**	
3	5.45	**D**	**H**	

Completing the (observed – expected) column requires that you subtract the value in the expected column from the value in the observed column for each row. Completing the (observed – expected)^2 column requires squaring the terms in the (observed – expected) column.

Practice Problem page 6, continued

Cell A: 3 - 5.45 = -2.45 Cell E: $(-2.45)^2 = 6.00$

Cell B: 7 – 4.55 = 2.45 Cell F: $(2.45)^2 = 6.00$

Cell C: 9 – 6.55 = 2.45 Cell G: $(-2.45)^2 = 6.00$

Cell D: 3 – 5.45 = -2.45 Cell H: $(2.45)^2 = 6.00$

page 7

observed	expected	(observed-expected)	(observed-expected)^2	(observed-expected)^2/ expected
3	5.45	-2.45	6.00	**A**
7	4.55	2.45	6.00	**B**
9	6.55	2.45	6.00	**C**
3	5.45	-2.45	6.00	**D**
				Σ = **E**

Completing the [(observed – expected)^2/expected] column requires dividing the value in the (observed – expected)^2 column by the value in the expected column for each row.

Cell A: 6.00/5.45 = 1.10

Cell B: 6.00/4.55 = 1.32

Cell C: 6.00/6.55 = 0.92

Cell D: 6.00/5.45 = 1.10

Cell E = 1.10 + 1.32 + 0.92 + 1.10 = 4.44

page 8

When looking up the critical Chi-square value in the Chi-square table for this problem, which level of significance should you use?

Answer: .05

This is always the answer to this question in this course!

When looking up the critical Chi-square value in the Chi-square table for this problem, what is the appropriate degrees of freedom value to use?

Answer: 1

For Chi square, degrees of freedom = (number of rows – 1) * (number of columns – 1). In this problem, we have 2 rows and 2 columns, so df = (2-1) * (2-1) = 1*1 = 1

Practice Problem page 8, continued
Which of the following is the correct critical Chi square value for this problem?

Answer: 3.841

According to the Chi square table, with a df value of 1, the critical value is 3.841.

Does the calculated Chi-square value indicate that the relationship between cat ownership and over/under toilet paper roll placement is statistically significant?

Answer: Yes, because the calculated Chi-square value is higher than the critical Chi-square value.

Calculated 4.44 > Critical 3.841. Anytime the calculated value is higher than the critical value, you can conclude that there is a significant relationship between variables.

Homework
page 1

OBSERVED	own	rent	total
decorate	**10**	**2**	12
do not decorate	**4**	**4**	8
total	14	6	20

The observed table simply summarizes the data.

EXPECTED	own	rent	total
decorate	**A**	**C**	12
do not decorate	**B**	**D**	8
total	14	6	20

To calculate the expected value for each cell, use this formula:

$$fe = (row\ total * column\ total)/N$$

Cell A: (12*14)/20 = 8.4

Cell B: (8*14)/20 = 5.6

Cell C: (12*6)/20 = 3.6

Cell D: (8*6)/20 = 2.4

What is the df for this problem?

Answer: 1

> For Chi square, degrees of freedom = (number of rows – 1) * (number of columns – 1).
> In this problem, we have 2 rows and 2 columns, so df = (2-1) * (2-1) = 1*1 = 1

Calculate the Chi square value.

Answer: 2.54

observed	expected	(observed-expected)	(observed-expected)^2	(observed-expected)^2/ expected
10	8.4	1.6	2.56	0.30
2	3.6	-1.6	2.56	0.71
4	5.6	-1.6	2.56	0.46
4	2.4	1.6	2.56	1.07
				Σ = 2.54

Homework page 1, continued

Use the Chi square table to find the critical Chi square value for this problem.

Answer: 3.841

Looking at the Chi square table, we find df=1 to find the critical value for this problem.

Based on your findings, can you reject the null hypothesis?

Answer: no

Because the calculated Chi square value (2.54) is lower than the critical Chi square value (3.841), we cannot conclude that the relationship between the two variables is significant. Therefore, we will fail to reject the null hypothesis.

page 2

OBSERVED	Home	Birthing Center	Hospital	Total
High School	0	1	7	8
College	2	3	3	8
Total	2	4	10	16

The observed table simply summarizes the data.

EXPECTED	Home	Birthing Center	Hospital	Total
High School	A	C	E	8
College	B	D	F	8
Total	2	4	10	16

To calculate the expected value for each cell, use this formula:

$$fe = (row\ total * column\ total)/N$$

Cell A: (8*2)/16 = 1 Cell C: (8*4)/16 = 2 Cell E: (8*10)/16 = 5

Cell B: (8*2)/16 = 1 Cell C: (8*4)/16 = 2 Cell F: (8*10)/16 = 5

What is the df for this problem?

Answer: 2

For Chi square, degrees of freedom = (number of rows – 1) * (number of columns – 1). In this problem, we have 2 rows and 3 columns, so df = (2-1) * (3-1) = 1*2 = 2

Homework page 2, continued
Calculate the Chi square value.

Answer: 4.60

observed	expected	(observed-expected)	(observed-expected)^2	(observed-expected)^2/ expected
0	1	-1	1	1.00
2	1	1	1	1.00
1	2	-1	1	0.50
3	2	1	1	0.50
7	5	2	4	0.80
3	5	-2	4	0.80
				Σ = 4.60

Use the Chi square table to find the critical Chi square value for this problem.

Answer: 5.991

Looking at the Chi square table, we find df=2 to find the critical value for this problem.

Based on your findings, can you reject the null hypothesis?

Answer: no

Because the calculated Chi square value (4.60) is lower than the critical Chi square value (5.991), we cannot conclude that the relationship between the two variables is significant. Therefore, we will fail to reject the null hypothesis.

OBSERVED	Human Resources	Accounting	Customer Service	Total
Park	1	3	8	12
Restaurant	3	3	4	10
Boss's House	2	7	2	11
Ice Skating Rink	6	3	8	17
Total	12	16	22	50

The observed table simply summarizes the data.

EXPECTED	Human Resources	Accounting	Customer Service	Total
Park	A	E	I	12
Restaurant	B	F	J	10
Boss's House	C	G	K	11
Ice Skating Rink	D	H	L	17
Total	12	16	22	50

To calculate the expected value for each cell, use this formula:

$$fe = (row\ total * column\ total)/N$$

Cell A: (12*12)/50 = 2.88 Cell E: (12*16)/50 = 3.84 Cell I: (12*22)/55 = 5.28

Cell B: (10*12)/50 = 2.40 Cell F: (10*16)/50 = 3.20 Cell J: (10*22)/50 = 4.40

Cell C: (11*12)/50 = 2.64 Cell G: (11*16)/50 = 3.52 Cell K: (11*22)/50 = 4.84

Cell D: (17*12)/50 = 4.08 Cell H: (17*16)/50 = 5.44 Cell L: (17*22)/50 = 7.48

What is the df for this problem?

Answer: 6

For Chi square, degrees of freedom = (number of rows – 1) * (number of columns – 1).
In this problem, we have 4 rows and 3 columns, so df = (4-1) * (3-1) = 3*2 = 6

Homework page 3, continued
Calculate the Chi square value.

Answer: 10.31

observed	expected	(observed-expected)	(observed-expected)^2	(observed-expected)^2/ expected
1	2.88	-1.88	3.53	1.23
3	2.40	0.60	0.36	0.15
2	2.64	-0.64	0.41	0.16
6	4.08	1.92	3.69	0.90
3	3.84	-0.84	0.71	0.18
3	3.20	-0.20	0.04	0.01
7	3.52	3.48	12.11	3.44
3	5.44	-2.44	5.95	1.09
8	5.28	2.72	7.40	1.40
4	4.40	-0.40	0.16	0.04
2	4.84	-2.84	8.07	1.67
8	7.48	0.52	0.27	0.04
				Σ = 10.31

Use the Chi square table to find the critical Chi square value for this problem.

Answer: 12.592

Looking at the Chi square table, we find df=6 to find the critical value for this problem.

Based on your findings, can you reject the null hypothesis?

Answer: no

Because the calculated Chi square value (10.31) is lower than the critical Chi square value (12.592), we cannot conclude that the relationship between the two variables is significant. Therefore, we will fail to reject the null hypothesis.

page 4

What is the independent variable in this problem?

Answer: race

The original question asked if race influences religious identification, so race is the independent variable. Could it be the other way around? Not likely.

Homework page 4, continued

Complete the expected values table for each cell containing a letter.

OBSERVED	Black	White	Hispanic	total
Protestant	50	60	15	125
Catholic	20	50	30	100
Jewish	5	20	5	30
total	75	130	50	255

EXPECTED	Black	White	Hispanic	total
Protestant	A			
Catholic		B		E
Jewish			C	
total				D

To calculate the expected value for each cell, use this formula:

$$fe = (row\ total * column\ total)/N$$

Cell A: (125*75)/255 = 36.8

Cell B: (100*130)/255 = 51.0

Cell C: (30*50)/255 = 5.9

Cell D: same as the total N in the observed table = 255

Cell E: same as the row total for Catholics in the observed table = 100

What is the df for this problem?

Answer: 4

For Chi square, degrees of freedom = (number of rows – 1) * (number of columns – 1).
In this problem, we have 3 rows and 3 columns, so df = (3-1) * (3-1) = 2*2 = 4

Homework page 4, continued
What is the calculated Chi square value?

Answer: 20.2

observed	expected	(observed-expected)	(observed-expected)^2	(observed-expected)^2/ expected
50	36.8	13.2	174.2	4.7
20	29.4	-9.4	88.4	3.0
5	8.8	-3.8	14.4	1.6
60	63.7	-3.7	13.7	0.2
50	51.0	-1.0	1.0	0.0
20	15.3	4.7	22.1	1.4
15	24.5	-9.5	90.2	3.7
30	19.6	10.4	108.2	5.5
5	5.9	-0.9	0.8	0.1
				Σ =20.2

Use the Chi square table to find the critical Chi square value for this problem.

Answer: 9.488

Looking at the Chi square table, we find df=4 to find the critical value for this problem.

Based on your findings can you reject the null hypothesis?

Answer: yes

Because the calculated Chi square value (20.2) is greater than the critical Chi square value (9.488), we have found evidence that race and religion are significantly related. Therefore, we can reject the null hypothesis.

Snack food problem
What is the independent variable?

Answer: gender

We're suggesting that one's preference for snack food is influenced by his or her gender. It could not be the other way around. (I used to be female, but I ate too many cheese curds, and now I'm male? No.)

Homework page 4, continued

Complete the expected values table for each cell containing a letter.

OBSERVED	Chips	Cookies	Fruits & vegetables	Nuts	Total
Female	145	45	50	35	275
Male	135	45	25	20	225
Total	280	90	75	55	500

EXPECTED	Chips	Cookies	Fruits & vegetables	Nuts	Total
Female	A	B			275
Male			C	D	225
Total	280	90	75	55	500

To calculate the expected value for each cell, use this formula:

$$fe = (row\ total * column\ total)/N$$

Cell A: (275*280)/500 = 154.00

Cell B: (275*90)/500 = 49.50

Cell C: (225*75)/500 = 33.75

Cell D: (225*55)/500 = 24.75

What is the df for this problem?

Answer: 3

For Chi square, degrees of freedom = (number of rows – 1) * (number of columns – 1).
In this problem, we have 2 rows and 4 columns, so df = (2-1) * (4-1) = 1*3 = 3

Homework page 4, continued

What is the calculated Chi square value?

Answer: 7.87

observed	expected	(observed-expected)	(observed-expected)^2	(observed-expected)^2/ expected
145	154.00	-9.00	81.00	0.53
135	126.00	9.00	81.00	0.64
45	49.50	-4.50	20.25	0.41
45	40.50	4.50	20.25	0.50
50	41.25	8.75	76.56	1.86
25	33.75	-8.75	76.56	2.27
35	30.25	4.75	22.56	0.75
20	24.75	-4.75	22.56	0.91
				Σ =7.87

Use the Chi square table to find the critical Chi square value for this problem.

Answer: 7.815

Looking at the Chi square table, we find df=3 to find the critical value for this problem.

Based on your findings can you reject the null hypothesis?

Answer: Yes

Because the calculated Chi square value (7.87) is (just barely!) greater than the critical Chi square value (7.815), we reject the null hypothesis, and conclude that gender has a significant influence on snack food preference.